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In the researched work, assemblages of nearly perfectly round plotoelastic disks were subjeted to confined compression, then sheared along an interface of varying roughness (very rough or very smooth). Overall, there was excellent comparison between the behavior observed in the physical system and the DEM simulations. Global response as measured by external wall forces, and individual particle kinematics were found to be in excellent agreement. Local contact forces and interactions were modeled generally well, but not as well as the global behavior.

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FINAL TECHNICAL REPORT
June 1,1996 to May 31, 1997

Behavior of Multiphase Granular Media: Modeling the Static-to-Viscous Flow Regime

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The original thrust of the research in this AASERT grant was to investigate the solidification of dense fluid suspensions by using Discrete Element Method (**DEM**) simulations. With the changing emphasis within the Particulate Mechanics task in AFOSR, it was decided in January 1996 after consultation and approval from the Interim Program Manager to modify the objectives in the AASERT research. The new thrust involved making extremely careful and controlled comparisons between our DEM analyses and physical interface shear tests data on photoelastic rods conducted by S.G. Paikowsky *et al* as part of their AFOSR-funded research.

In Paikowsky's work, assemblages of nearly perfectly round photoelastic disks were subjected to confined compression, then sheared along an interface of varying roughness (very rough or very smooth).Overall, there was excellent comparison between the behavior observed in the physical system and the DEM simulations. Global response as measured by external wall forces, and individual particle kinematics were found to be in excellent agreement. Local contact forces and interactions were modeled generally well, but not as well as the global behavior.

The details of whether an assemblage is modeled as an assemblage of completely uniform-sized particles, or an assemblage with very slight size variations was found to be a crucial factor in the level of agreement between the physical and numerical systems. In general, even minute variations in particle size can significantly alter the local contact behavior in the DEM simulations. By using a gradation of particle sizes matching the actual observed particle gradation, generally excellent comparisons were made. While it was intended that tests using particles of round as well as ellipse shapes would be compared, the results from the physical tests composed of ellipse shapes were not provided to us.

One US citizen graduate student (Gregory Mischel) was fully supported during his graduate career from this AASERT grant (he received full tuition waivers from UMass Lowell during each semester here, a non-required part of our cost-sharing effort). This student has completed his coursework requirements, is currently finishing his thesis, and should graduate by early fall. As well, one US citizen undergraduate student (Apryl Wilson) was supported for one month this spring on this contract. The grades for both students are satisfactory.

In addition to the research summarized above, Gregory Mischel also participated in a major international collaborative research effort on pressures within silos filled with granular materials, spearheaded by the University of Edinburgh and the UK Engineering and Physical Sciences Research Council. In this *pro bono* collaboration, simulations of silo filling and discharging were conducted using round and ellipse-shaped particles, for comparison with other DEM and Finite Element analyses. These results will be fully documented in Mischel's thesis.